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C PROMYSLOVOM VOZVRATE LOSOSEI ZAVODSKOGO PROISKHOZHDENIYA

THE YIELD TO THE FISHERY OF HATCHERY SALMON

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Pink salmon. All our pink salmon hatcheries are located at rivers where, together with the artificial reproduction, there also is natural reproduction. It is why an evaluation of the effectiveness of pink salmon rearing requires special methods. We have used two methods. The traditional method of tagging the planted juvenile fish (Pritchard, 1933, 1934; Lister, 1981; Fred Report, 1982) and a calculation method. In the latter case, the total yield of juvenile fish is calculated as the sum of downstream migration and release. Assuming that the survival rate of the hatchery and naturally reared young fishes is the same, the share of hatchery pink salmon in the yield to the fishery is determined proportionally to its share in the overall crop of juvenile fish. Neither of these two methods is irreproachable and both are open to criticism. In the first case, the source of errors is the natural origin of anomalies of the fins - traumas, deformities - that may be mistaken for tags. This refers above all to the adipose fin, where the incidence of natural anomalies may be quite considerable and capable of distorting the calculation data 7 to 10 times. In the second case, these are errors relative to the evaluation of the degree of filling of the spawning grounds and downstream migration of juvenile fish which occur during the extrapolation of data from the surveyed rivers for the entire region under study.

Calculations show that, for instance, in south-eastern Sakhalin,

in one of the most important pink salmon rearing districts, the coefficients of yield to the fishery of fish of a mixed origin fluctuated within the limits of 0.8 - 6.2%. But if one assumes that there was no yield from the hatchery-reared juvenile fish, these figures increase in some years up to 12, 15 and 33%, which defies common sense and definitely points to the role of artificial culture. The calculations of commercial yield of hatchery-reared pink salmon for the three main rearing regions in the Sakhalin province are shown in Table 1. /2

Another shortcoming of the calculation method resides in the fact that it allows one to evaluate the effectiveness of rearing for whole regions but not for each individual rearing station. In the latter case we are using the tagging method.

Tagging the juvenile pink salmon started already in the 1960's, but it was applied with better planning and on a large scale beginning with 1976. In all eleven fish hatcheries, where pink salmon are reared on a permanent basis or periodically, tagging has been used, as a rule, at least two or three times in each of them. It consisted in the amputation of one of the pelvic fins, the adipose or the dorsal fin, separately or jointly. The single volume of tagged juvenile fish was of 0.3 - 1 million specimens. The yield-to-the-fishery coefficients obtained by this method are indicated by taking into account the possible existence of anomalies in the fins that might have been mistaken for tags. These corrections are subjective at times and do not tally with the calculation method data.

Our research shows that all pink salmon hatcheries may be divided into three groups with regard to effectiveness.

1. Highly effective hatcheries. We consider as belonging to this group two hatcheries on the Iturup island (Kurilskii and Reidovyi) and one hatchery in south-eastern Sakhalin (Lesnoi). The total volume of juvenile fish released from these hatcheries amounts to 250 million specimens, the yield to 1.3 - 6.2%. The tagging data agree well with those obtained by calculation, and they also are confirmed by the large

numbers of pink salmon caught at the coast in the areas of release and by the spawners that enter the base rivers of the hatcheries. One should put in this category perhaps also another large hatchery of south-eastern Sakhalin, namely the Bereznyakovskii, where a single tagging revealed a 2.2% yield to the fishery. However, this figure /4 is not always confirmed by spawners actually entering the base river of the hatchery.

2. The second group, of reasonably effective hatcheries, comprises two fish-rearing stations in the Aniva bay, which have a total capacity of up to 50 million. The yield to the fishery has been reliably estimated here by various methods at 0.6 - 0.8%.

3. The third group - of uneffective hatcheries - includes two small fish-rearing stations in south-eastern Sakhalin (Ainskii and Urozhainyi) and two in cetral Sakhalin (Pobedinskii and Buyuklovskii). Rearing pink salmon at these hatcheries is pointless, since the yield to the fishery does not exceed 0.01 - 0.19%. Two other large fish-rearing stations in south-eastern Sakhalin - Sokolovskii and Pugachevskii - also must be placed in this category. The three tagging operations carried out in each of these hatcheries revealed a yield of 0.09, 0.29 and 0.13% (Sokolovskii) and 0.25, 0.53 and 0.07% (Pugachevskii). In the latter case, the tagging results are confirmed by low numbers of spawners entering the Pugachevka River. But at the Sokolovskii station, in spite of low yield coefficients obtained by tagging, heavy runs of spawners are observed in many cases. This situation calls for further research.

Chum salmon. An evaluation of the effectiveness of chum rearing offers no difficulty. Considering the absence of coastal fish industry and natural reproduction in most rivers where this species is artificially propagated, there is no need for tagging juvenile fish. All chum salmon returning to the hatchery weirs have been reared at the station, the Ado-Tymovskii hatchery being an exception. As an example, the tables show the yield coefficients in a number of chum-rearing stations.

Table 1

Commercial yield of hatchery-reared pink salmon

Years: release - catch	South-eastern Sakhalin		Aniva Bay		Iturup Island	
	release, million	yield %	release, million	yield %	release, million	yield %
1964-65	81	0,3	37	1,2	134	1,0
1965-66	38	0,2	32	0,4	23	0,7
1966-67	88	0,5	18	2,9	143	0,8
1967-68	78	0,3	36	0,6	76	0,6
1968-69	188	0,3	48	1,6	134	1,0
1969-70	108	0,03	17	0,3	88	0,4
1970-71	191	0,6	40	1,4	143	2,8
1971-72	87	0,2	17	0,4	94	1,9
1972-73	173	1,1	36	1,6	137	2,3
1973-74	137	1,0	23	4,9	97	1,9
1974-75	230	2,9	42	1,1	136	2,0
1975-76	240	1,9	40	3,0	141	1,6
1976-77	280	2,7	54	3,7	173	3,9
1977-78	252	1,6	52	0,7	186	3,0
1978-79	250	1,4	36	0,7	145	4,0
1979-80	269	2,6	64	1,5	214	3,5
1980-81	286	1,1	43	1,3	209	2,1
1981-82	310	0,3	50	0,4	218	2,6
1982-83	264	1,0	17	2,5	221	6,0
1983-84	264	0,1	21	0,2	221	1,9
1984-85	316	1,6	53	2,9	223	9,8
1985-86	56	0,3	30	0,1	145	2,0

Table 2

Numbers and yield coefficient of chum at the Kalininskii hatchery

Year of release of juvenile fish	Juvenile fish released, million	Specimens returned					Total return	Yield coefficient %
		1+	2+	3+	4+	5+		
1952	6,53		775	17911	265		18951	0,290
1953	11,44		979	12742	1765		15486	0,135
1954	8,57		173	11805	5065		17043	0,199
1955	8,61	93	16855	72947	9487	83	99465	1,155
1956	16,81		10840	78804	2450	578	92472	0,550
1957	13,96		2259	20039	5280		25938	0,186
1958	17,96		4597	40496	14342	1221	60656	0,338
1959	25,56		1769	18413	13009		33191	0,130
1960	25,30		2202	30898	4487		37587	0,149
1961	22,30		10111	147621	26243	2284	186259	0,835
1962	30,83	177	20719	136350	64937	2690	224873	0,729
1963	27,42		1137	96430	45723	1594	144884	0,528
1964	33,14			86067	44370	734	131171	0,396
1965	35,65			92953	12738	2962	108653	0,305
1966	39,79		3955	130583	62126	803	197467	0,496
1967	48,59		7806	82720	30367	9402	130265	0,268
1968	55,14			202157	46308	914	249379	0,452
1969	56,07		1837	66389	13162		81388	0,145
1970	56,72		7027	98544	55739		161410	0,287
1971	56,59		5250	165808	57617		228675	0,404
1972	58,87		9394	105763	25843		141026	0,240
1973	68,98		6801	40969	27850		75440	0,109
1974	74,10		1364	60412	27850		89625	0,121
1975	83,36		8323	526365	331418	842	868354	1,040
1976	89,30		2765	140316	72984	4145	220230	0,247
1977	86,70		1686	36235	45599		83500	0,096
1978	88,14		3590	156489	221190	13559	394828	0,448
1979	87,38		1036	59150	44892		105078	0,132
1980	80,10		50	6289	-	-	6339	(0,007)

0,24

Table 3

Numbers and yield coefficient of chum at the Yasnomorskii hatchery

Year of release of juvenile fish	Released, million	Specimens returned					Total return	Yield coefficient %
		1+	2+	3+	4+	5+		
1952	6,3		144	1094	20		1258	0,020
1953	5,8		60	953	187		1210	0,021
1954	0,9		13	1252			1265	0,141
1955	2,22	7	1769	4026	404	15	6241	0,281
1956	7,61		598	3349	448	94	4489	0,059
1957	3,45		96	3729	511		4335	0,126
1958	9,94		841	6317	4475	156	11789	0,119
1959	10,69		279	5752	5621		11652	0,109
1960	11,92		687	7049	263		7999	0,067
1961	5,05		156	8642	724		9522	0,189
1962	11,42		1214	3769	840	71	5894	0,052
1963	10,30		32	1686	636	57	2411	0,023
1964	11,63			2023	596	241	2860	0,025
1965	14,62		187	2678	827	170	3862	0,026
1966	16,67		239	6050	3576		9865	0,059
1967	15,87		197	4768	1582	1213	7760	0,049
1968	15,88			15819	7322	88	23229	0,146
1969	16,50		176	6982	1624	211	8993	0,054
1970	16,70		532	5690	3162	56	9440	0,057
1971	16,50		547	10417	5651		16615	0,101
1972	16,60		849	5003	1434		7286	0,044
1973	16,70		514	5216	3603		9333	0,056
1974	16,40		485	7166	9967		17618	0,107
1975	16,30		2625	33556	22898	130	59209	0,363
1976	16,80		-	6785	2665	526	9396	0,056
1977	7,40		209	1764	8154	25	10152	0,137
1978	16,60		373	17096	16161	1376	35026	0,211
1979	16,95		526	32595	18112		51233	0,243
1980	17,10		30	5691	-	-	5721	(0,037)

Table 4

Numbers and yield coefficient of chum at the Sokolnikovskii hatchery

Year of release of juvenile fish	Released, million	Specimens returned				Total return	Yield coefficient %
		2+	3+	4+	5+		
1952	6,40	975					
1953	5,40			365			
1954	0,90		2439				
1955	9,00	3482	16502	1160	76	21220	0,236
1956	7,34	2450	17180	1770		21400	0,292
1957	14,30	965	12740	1680		15385	0,108
1958	17,92	4650	17860	9226		31736	0,177
1959	15,00	505	15025	7188		22718	0,151
1960	13,81	2108	20017	5935	311	28371	0,205
1961	10,41	2287	28920	5330	190	36727	0,353
1962	17,90	3445	17948	10716	100	32209	0,180
1963	14,70	311	8060	1239	1100	10710	0,073
1964	18,15	230	14514	3350	207	18301	0,101
1965	18,80	1947	20000	2070	700	24717	0,131
1966	19,76	550	17595	10500	311	28956	0,147
1967	20,07	828	23100	5589	729	30246	0,151
1968	20,43	700	25153	11552	258	37663	0,184
1969	20,00	-	10579	2378	425	13382	0,067
1970	21,10	1459	18338	8801		28598	0,136
1971	20,90	2514	28996	10273		41783	0,200
1972	21,70	4294	23813	3469		31596	0,146
1973	20,40	8362	10467	11241		30070	0,147
1974	22,20	1214	17318	27065		45597	0,205
1975	22,90	1823	110284	82787	121	194995	0,852
1976	23,60	7237	29584	6031	876	43728	0,185
1977	21,20	565	5870	9242	92	15869	0,075
1978	2280	61	25799	26702	2089	54651	0,240
1979	23,87	7804	18507	7707		34018	0,143
1980	24,20	-	354	-	-	354	(0,001)